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336313 Underground Steam Condensate Distribution Piping

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SECTION 33 6313 – UNDERGROUND STEAM AND CONDENSATE DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes underground piping outside the building for distribution of steam and condensate. A. Design and provide exterior underground factory-prefabricated and pre-insulated steam and condensate piping distribution system, complete and ready for operation. Design ratings of system components: Steam maximum design pressure at 150 psig at 366 °F, working pressure at 90 psig at 331°F, and condensate at 20 psig at 210°F.

RELATED SECTIONS FOUND ELSEWHERE

- B. See Chapter 5, Division 01, Section 017700.1.1.B.1.i Closeout Procedures - Project Record Documents for equipment list requirements for all equipment provided in this section.
- C. See Chapter 5, Division 23, Section 231800, for requirements related to district heating and cooling plant requirements.

1.2 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- B. Most recent editions of applicable specifications and publications of the following organizations:
 - 1. American National Standards Institute (ANSI).
 - 2. American Society of Mechanical Engineers (ASME).
 - 3. American Welding Society (AWS).
 - 4. National Association of Corrosion Engineers (NACE).
- C. The manufacturer of the conduit system is responsible for the complete design of the system, the product to be supplied, fabrication, witnessing installation and testing of the system. The complete design of the system shall be prepared, signed and sealed by a registered professional engineer employed by the system manufacturer.
- D. Installer: Company specializing in performing the work of this section with minimum ten years of experience. Welders: Certify in accordance with ASME SEC 9 and AWS D1.1.



PART 2 - PRODUCTS

2.1 MANUFACTURERS

- a. Rovanco Piping Systems, Inc.
- b. Insul-Tek Piping Systems, Inc.
- c. Perma-Pipe, Inc.

2.2 PREINSULATED UNDERGROUND PIPING SYSTEM

- A. General: Underground pre-insulated high-pressure steam and pumped condensate conduit distribution piping. Both steam and condensate piping shall be furnished in separate conduits with polyethylene jacket, Pyrogel XT-E insulation, and steel carrier pipes. Straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions, and designed to minimize the number of field welds. Where possible, straight sections shall be supplied in 40-foot random lengths with 6 inches of exposed piping at each end for field fabrication. Each system layout shall be computer analyzed by the piping system manufacturer to determine the stresses and movements of the service pipe. The system shall be in strict conformance with ANSI B31.1 latest edition. Submittal drawings and stress-analysis calculations shall be stamped by a New Hampshire registered professional engineer.
- B. Carrier Pipes: Steam carrier pipe shall be true schedule 80 black steel, ASTM A106, Grade B, seamless, condensate carrier pipe shall be schedule 80 black steel, ASTM A106B, seamless. Schedule Extra-Strong steam carrier pipes shall not be acceptable.
- C. Carrier Pipe Insulation:
 1. Insulation shall be Pyrogel XT-E high temperature insulation blanket of silica Aerogel and reinforced with a non-woven, glass-fiber batting sectional molded pipe insulation, as manufactured by Aspen Aerogel. The insulation shall have a thermal K-factor of 0.19 at a mean temperature of 200°F. Insulation shall comply with ASTM C 1728, Type III, Grade 1A.
 2. Insulation shall be banded on the carrier pipe with aluminum or stainless steel banding on 18 inch centers.
 3. The minimum carrier pipe insulation thickness shall as specified below:

| Carrier Pipe Size/Service | Minimum Thickness |
|---------------------------|-------------------|
| 2" HPS | 1.18" (30mm) |
| 2-1/2" HP | 1.18" (30mm) |
| 3" HPS | 1.18" (30mm) |
| 4" HPS | 1.18" (30mm) |
| 5" HPS | 1.38" (35mm) |
| 6" HPS | 1.38" (35mm) |
| 8" HPS | 1.38" (35mm) |



| | |
|------------|--------------|
| 10" HPS | 1.38" (35mm) |
| 12" HPS | 1.57" (40mm) |
| 1" PCR | 0.19" (5mm) |
| 1-1/4" PCR | 0.19" (5mm) |
| 2" PCR | 0.19" (5mm) |
| 2-1/2" PCR | 0.19" (5mm) |
| 3" PCR | 0.19" (5mm) |
| 4" PCR | 0.39" (10mm) |
| 5" PCR | 0.39" (10mm) |

D. Inner Pipe Supports: Carrier pipes shall be aligned and supported within the outer conduit with galvanized steel supports spaced on centers approximately 10 feet. The insulated carrier pipe shall bear directly on the steel support. The support shall be designed as to permit drainage and free air passage. Piping passing through the supports shall be insulated. Concrete type supports shall not be permitted.

E. Inner Conduit:

1. The inner conduit shall be spiral butt welded, smooth wall, 10-gauge steel, conforming to the requirements of ASTM A139.
2. The interior surface of the inner conduit shall be smooth to permit free moisture drainage and removability of the inner assembly.
3. The inner conduit shall be sized to provide a 3/4" inch minimum annular space between the outer surface of the carrier pipe insulation material and the interior surface of the conduit.

F. Inner Conduit Casing Insulation:

1. Conduit insulation shall be foamed-in-place HT-450 closed cell polyisocyanurate foam for both steam and condensate service, as manufactured by HiTherm, LLC, and capable of continuous operating temperatures of 400 °F with intermittent service to 450 °F. Sectional preformed insulation shall not be acceptable.
 - a. Initial Thermal Conductivity (k-Value): 0.13 at 75 deg F., ASTM C-518-91.
 - b. Continuous Service Temperature: Minus 100 to plus 400 deg F.
 - c. Water Absorption: 0.035 lb/sq.ft., ASTM D-2842.
 - d. Closed Cell Content: 87%, ASTM D-2856.
 - e. Density: 2.45 lb/cu.ft., ASTM D-1622.
 - f. Compressive Strength, Parallel to Rise: 30 psig, ASTM D-1621.
2. The minimum inner conduit casing insulation thickness shall as specified below:

| Carrier Pipe Size/Service | Minimum Conduit Size | Minimum Thickness |
|---------------------------|----------------------|-------------------|
| 2" HPS | 6.625" | 1.51" |
| 2-1/2" HPS | 8.625" | 1.72" |
| 3" HPS | 8.625" | 1.72" |
| 4" HPS | 8.625" | 1.72" |



| | | |
|------------|--------|-------|
| 5" HPS | 10.75" | 1.48" |
| 6" HPS | 12.75" | 1.38" |
| 8" HPS | 14.00" | 1.74" |
| 10" HPS | 16.00" | 1.70" |
| 12" HPS | 18.00" | 1.88" |
| 1" PCR | 3.50" | 1.35" |
| 1-1/4" PCR | 4.50" | 1.57" |
| 1-1/2" PCR | 4.50" | 1.57" |
| 2" PCR | 4.50" | 1.57" |
| 2-1/2" PCR | 6.625" | 1.51" |
| 3" PCR | 6.625" | 1.51" |
| 4" PCR | 8.625" | 1.72" |
| 5" PCR | 8.625" | 1.72" |

- G. Outer Jacket: Preformed heavy duty seamless HDPE casing conforming to ASTM D3350-12, minimum cell classification of PE334360C, and containing a minimum of 2% carbon black. Minimum thickness shall be 175 mils. Spiral wrap or jackets extruded over the insulation are not acceptable.
1. Thermal Stability: 428 deg. F (220 deg. C), ASTM D3350.
 2. Minimum Radial Tensile Elongation (@ yield): 200%, ASTM D638.
 3. Tensile Value (@ yield): 2,500 psi, ASTM D638.
 4. The minimum outer jacket size and wall thickness shall be as specified below:

| Carrier Pipe Size/Service | Mini- Jacket Size |
|------------------------------|-------------------------|
| 2" HPS | 10.00" |
| 2-1/2" HPS | 12.43" |
| 3" HPS | 12.43" |
| 4" HPS | 12.43" |
| 5" HPS | 14.06" |
| 6" HPS | 15.87" |
| 8" HPS | 17.83" |
| 10" HPS | 19.80" |
| 12" HPS | 22.17" |
| 1" PCR | 6.60" |
| 1-1/4" PCR | 8.00" |
| 1-1/2" PCR | 8.00" |
| 2" PCR | 8.00" |
| 2-1/2" PCR | 10.00" |
| 3" PCR | 10.00" |
| 4" PCR | 12.43" |
| 5" PCR | 12.43" |

- H. Outer Conduit Closures:

1. Carrier pipe insulation shall be Pyrogel XT-E of the same thickness as prefabricated



- units and banded on the pipes with aluminum or stainless steel banding and clips.
 2. Inner conduit casing closures shall consist of 10-gauge steel suitably rustproofed and in cylindrical form with two horizontal splits, and shall be field welded over adjacent prefabricated units.
 3. Inner Conduit Casing Insulation shall be pre formed HT-450 Polyisocyanurate half shells, covered with preformed HDPE jacketing having the same physical characteristics as the prefabricated units.
 4. After successful completion of testing, cover exposed closures in the field with CANUSA CSC-X cross-linked high-density polyethylene heat shrink material in tubular form, without split. CSC-X closure sleeves must be temporarily pre-installed onto outer jacket ends at each field joint prior to welding of carrier pipe as they cannot be split and installed after welding.
- I. Expansion Loops and Elbows:
1. Expansion loops and expansion elbows shall be determined and designed by the manufacturer. The manufacturer shall submit for approval a complete stress analysis calculation supporting their design.
 2. Expansion loops and expansion elbows shall be furnished and enclosed in the same type of casing as those furnished for the standard straight sections of the system. They shall be of a size to permit the inner pipe to move without damage to the insulation material.
 3. Expansion loops and expansion elbows shall be prefabricated and shipped to the job site in as few pieces as possible, in accordance with manufacturer's recommendations.
 4. Cold springing of the carrier pipes shall not be acceptable.
- J. Anchors:
1. Anchors shall be prefabricated onto the piping units and shall be equipped with drainage and vent openings at the top and bottom of the anchor plate.
 2. Anchor plates shall be fabricated from 3/4 inch thick steel plate conforming to ASTM A36.
- K. End Seals and Gland Seals:
1. Terminal ends of conduit system inside manholes, pits, or building walls shall be equipped with end seals consisting of a steel bulkhead plate welded to the carrier pipe and outer conduit.
 2. Where there is no anchor within 5 feet of a terminal end, conduits shall be equipped with gland seals consisting of a packed stuffing box and gland follower, mounted on a steel plate welded to the end of the outer conduit.
 3. End seals and gland seals shall be fabricated from 1/2 inch thick steel plate with vent and drain openings located diametrically opposite on the vertical centerline of the mounting plate, and shall be shipped to the job site with threaded plugs in place.
- L. Terminate conduits 2 inches beyond the inside face of entry walls to protect any exposed pipe insulation from damp wall condensation.
- M. Corrosion Protection Overlay:



1. Rhinocoat Silvertip anodic metallic corrosion protection shall be factory applied on all exposed surfaces of metal including anchors, end seals and gland seals.
2. The steel surfaces must be shot-blasted with abrasives to a near white finish to SSPC10 prior to application.
3. Factory apply product having a minimum thickness of not less than 20 mils of molten metal.

2.3 WALL PENETRATIONS AND WALL SEALS

- A. Wall penetrations shall be made using either the core-drilling method or with Standard Weight Steel pipe. The penetration opening size shall be selected to coordinate with the proper size and number of modular rubber seals recommended by the supplier.
- B. Steel wall sleeves shall be made from schedule 40 or standard weight black steel pipe conforming to ASTM A53, Grade B, ERW or seamless. They shall have a full circle steel waterstop plate, 2 inches larger than, and continuously welded to, the sleeve. Assembly shall be protected with a cold-applied galvanizing paint coating, two coats minimum.

2.4 MANHOLES: BLACK STEEL WITH LIFTING EYES

1. Access: 36-inch- (750-mm-) diameter waterproof cover with gasket.
2. Link seals at all penetrations.
3. Sump: 12 inches (300 mm) in diameter, 12 inches (300 mm) deep.
4. Floatation Anchor: Oversized bottom keyed into concrete base.
5. No hinged covers.

PART 3 - EXECUTION

3.1 GENERAL

- A. The conduit system manufacturer shall oversee the delivery, storage, installation and testing of the system.

3.2 EXCAVATION, TRENCHING, AND BACKFILLING

- A. Perform excavation, trenching, and backfilling as required by the system manufacturer's design and as specified in other Sections.
- B. Beach sand or any sand with large amounts of chlorides shall not be permitted. Place system on a 4 to 6-inch thick sand bed, and backfill on all sides with 12-inch thick sand as measured from the outside of the conduit casings. Backfill with 12-inch thick sand over top of conduit casing, as measured from outside of largest conduit.
- C. Foundation and backfill must be free from rocks or substances that could damage the system coating.
- D. Pressure test the conduit system for both the carrier pipes and the inner conduit casings,



to the satisfaction of the manufacturer's representative.

3.3 FIELD SERVICE INSPECTION

- A. A field service representative, who is certified in writing by the conduit manufacturer to be technically qualified and experienced in the installation of the system, shall be present on the job site for a minimum of 3 visits. The field service representative shall be present when the following work is performed.
 - 1. Inspection of concrete anchors and thrust blocks.
 - 2. Cold springing.
 - 3. Field joint closure, initial instruction.

3.4 TESTING

- A. Hydrostatically test carrier pipes at 1-1/2 times system design pressure or 150 psig, whichever is higher, for a period of no less than 4-hours prior to insulating joints and closing outer conduit casing. Repair leaks by welding, and retest the system. All tests to be witnessed by owner or owner's representative.
- B. Air test inner steel conduit casings with compressed air at 15 psig before backfilling for 4 hours. Test field closure joints with a soap and water solution. Repair leaks by welding.
 - 1. Furnish necessary equipment and labor to perform the air test, including air compressor, gauges, conduit caps, temporary pipe and connections, and other accessories, and complete the test to the satisfaction of the Engineer.

END OF SECTION 33 6313